Lei Wang

Curriculum Vitae

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Personal data

Day of Birth	1st December 1983	Place of Birth	Nanjing
Sex	Male	Nationality	China
Researcher ID	B-1787-2010	Erdős Number	2 (through Gergely Harcos)

Academic Positions

2016.3– Present **Assistant Professor**, *Institute of Physics, Chinese Academy of Sciences*, Beijing, China.

2015.6 – 2016.2 **Senior research assistant (Oberassistent I)**, *ETH*, Zurich, Switzerland.

2011.9 – 2015.5 **Postdoctoral research assistant**, *ETH*, Zurich, Switzerland.
Supervisor: Prof. Dr. Matthias Troyer

Education

2006.9– 2011.7 **PhD in Physics**, *Institute of Physics, Chinese Academy of Sciences*, Beijing, China.
Supervisors: Prof. Xincheng Xie and Prof. Xi Dai

2002.9– 2006.6 **BSc in Physics**, *Nanjing University*, Nanjing, China.

Interests

Algorithmic Design	Design new efficient algorithms for strongly correlated quantum matter
Machine Intelligence	Computational intelligence and its application in scientific discoveries
Ultracold Atoms	Study topological phases and non-equilibrium dynamics in ultracold atomic gases

Skills

Numerical methods	Density functional theory, exact diagonalization, variational and quantum Monte Carlo methods, Gutzwiller approach, matrix product state methods and dynamical mean field theory.
Programming languages	Large scale high performance computing with C++, Python and Fortran.

Awards

2009–2010 **Director's scholarship**, *Institute of Physics.*

2009–2010 **Excellent student awards**, *Graduate School of Chinese Academy of Sciences.*

2003–2006 **Renmin scholarship**, *Nanjing University.*

Publications

[1] **Lei Wang**, Xi Dai, Shu Chen, and X. C. Xie. *Magnetism of cold fermionic atoms on the p band of an optical lattice.* Phys. Rev. A **78**, 023603 (2008).

[2] XiaoYu Deng, **Lei Wang**, Xi Dai, and Zhong Fang. *Local density approximation combined with Gutzwiller method for correlated electron systems: Formalism and applications.* Phys. Rev. B **79**, 075114 (2009).

[3] Jia Ning Zhuang, **Lei Wang**, Zhong Fang, and Xi Dai. *Fast impurity solver based on Gutzwiller variational approach.* Phys. Rev. B **79**, 165114 (2009).

[4] Hua Jiang, **Lei Wang**, Qing-feng Sun, and X. C. Xie. *Numerical study of the topological anderson insulator in HgTe/CdTe quantum wells.* Phys. Rev. B **80**, 165316 (2009).

[5] **Lei Wang**, Hua Jiang, J. N. Zhuang, Xi Dai, and X. C. Xie. *Spin current through an ESR quantum dot: A real-time study.* Phys. Rev. B **81**, 075323 (2010).

[6] Zi Cai, **Lei Wang**, X. C. Xie, and Yupeng Wang. *Interaction-induced anomalous transport behavior in one-dimensional optical lattices.* Phys. Rev. A **81**, 043602 (2010).

[7] Jian-Qing Qi, **Lei Wang**, and Xi Dai. *Antiferromagnetism of repulsively interacting fermions in a harmonic trap.* Chinese Physics Letters **27**, 083102 (2010).

[8] Zi Cai, **Lei Wang**, X. C. Xie, U. Schollwöck, X. R. Wang, M. Di Ventra, and Yupeng Wang. Quantum spinon oscillations in a finite one-dimensional transverse Ising model. Phys. Rev. B **83**, 155119 (2011).

[9] **Lei Wang**, Xi Dai, and X. C. Xie. *Frequency domain winding number and interaction effect on topological insulators.* Phys. Rev. B **84**, 205116 (2011).

[10] **Lei Wang**, Hua Jiang, Xi Dai, and X. C. Xie. *Pole expansion of self-energy and interaction effect for topological insulators.* Phys. Rev. B **85**, 235135 (2012).

[11] **Lei Wang**, Xi Dai, and X. C. Xie. *Interaction-induced topological phase transition in the Bernevig-Hughes-Zhang model.* Europhysics Letter **98**, 57001 (2012).

[12] Thomas Uehlinger, Daniel Greif, Gregor Jotzu, Leticia Tarruell, Tilman Esslinger, **Lei Wang** and Matthias Troyer. *Double transfer through Dirac points in a tunable honeycomb optical lattice.* Eur. Phys. J. Special Topics, **217**, 121 (2013). (Cover image)

[13] Hsiang-Hsuan Hung, **Lei Wang**, Zheng-Cheng Gu and Gregory A. Fiete. *Topological phase transition in a generalized Kane-Mele-Hubbard model: A combined Quantum Monte Carlo and Green's function study.* Phys. Rev. B **87**, 121113(R) (2013).

[14] **Lei Wang**, Alexey A. Soluyanov and Matthias Troyer. *Proposal for direct measurement of topological invariants in optical lattices.* Phys. Rev. Lett **110**, 166802 (2013).

[15] Zi Cai, Hsiang-Hsuan Hung, **Lei Wang**, Dong Zheng and Congjun Wu. *Pomeranchuk cooling of the SU(2N) ultra-cold fermions in optical lattices.* Phys. Rev. Lett **110**, 220401 (2013).

[16] **Lei Wang**, Matthias Troyer and Xi Dai. *Topological charge pumping in a one-dimensional optical lattice.* Phys. Rev. Lett **111**, 026802 (2013).

[17] Zi Cai, Hsiang-Hsuan Hung, **Lei Wang** and Congjun Wu. *Quantum magnetic properties of the SU(2N) Hubbard model in the square lattice: a quantum Monte Carlo study.* Phys. Rev. B **88**, 125108 (2013).

[18] **Lei Wang** and Matthias Troyer. *Seeing Hofstadter's Butterfly in Atomic Fermi Gases.* Phys. Rev. A **89**, 011603(R) (2014).

[19] Jakub Imriška, Mauro Iazzi, **Lei Wang**, Emanuel Gull, Daniel Greif, Thomas Uehlinger, Gregor Jotzu, Leticia Tarruell, Tilman Esslinger and Matthias Troyer. *Thermodynamics and magnetic properties of the anisotropic 3D Hubbard model*, Phys. Rev. Lett **112**, 115301 (2014).

[20] Hsiang-Hsuan Hung, Victor Chua, **Lei Wang** and Gregory A. Fiete. *Finite-size and interaction effects on topological phase transitions via numerically exact quantum Monte Carlo calculations*, Phys. Rev. B **89**, 235104 (2014).

[21] **Lei Wang** and Matthias Troyer. *Renyi Entanglement Entropy of Interacting Fermions Calculated Using Continuous-Time Quantum Monte Carlo Method*, Phys. Rev. Lett. **113**, 110401 (2014).

[22] **Lei Wang**, Philippe Corboz and Matthias Troyer. *Fermionic Quantum Critical Point of Spinless Fermions on a Honeycomb Lattice*, New J. of Phys., **16**, 103008 (2014), selected by the Editors for IOPselect.

[23] **Lei Wang**, Hsiang-Hsuan Hung and Matthias Troyer. *Topological Phase Transition in the Hofstadter-Hubbard Model*, Phys. Rev. B **90**, 205111 (2014).

[24] **Lei Wang**, Mauro Iazzi, Philippe Corboz and Matthias Troyer. *Efficient Continuous-time Quantum Monte Carlo Method for the Ground State of Correlated Fermions*, Phys. Rev. B **91**, 235151 (2015), Editors' suggestion.

[25] **Lei Wang**, Ye-Hua Liu, Jakub Imriška, Ping Nang Ma, Matthias Troyer. *Fidelity susceptibility made simple: A unified quantum Monte Carlo approach*, Phys. Rev. X **5**, 031007 (2015).

[26] **Lei Wang**, Hiroshi Shinaoka, Matthias Troyer. *Fidelity Susceptibility Perspective on the Kondo Effect and Impurity Quantum Phase Transitions*, Phys. Rev. Lett. **115**, 236601 (2015).

[27] Ye-Hua Liu and **Lei Wang**. *Quantum Monte Carlo study of mass-imbalanced Hubbard models*, Phys. Rev. B **92**, 235129 (2015), Editors' suggestion.

[28] **Lei Wang**, Ye-Hua Liu, Mauro Iazzi, Matthias Troyer, Gergely Harcos. *Split orthogonal group: A guiding principle for sign-problem-free fermionic simulations*, Phys. Rev. Lett. **115**, 250601 (2015).

[29] Shuta Nakajima, Takafumi Tomita, Shintaro Taie, Tomohiro Ichinose, Hideki Ozawa, **Lei Wang**, Matthias Troyer, Yoshiro Takahashi. *Topological Thouless Pumping of Ultracold Fermions*, Nature Physics **12**, 296 (2016).

[30] **Lei Wang**, Ye-Hua Liu and Matthias Troyer. *Stochastic series expansion simulation of the t-V model*, Phys. Rev. B **93**, 155117 (2016).

[31] Jakub Imriška, **Lei Wang**, Matthias Troyer. *First order topological phase transition of the Haldane–Hubbard model*, Phys. Rev. B **94**, 035109 (2016).

[32] Ilia Zintchenko, **Lei Wang** and Matthias Troyer. *Ferromagnetism of the Repulsive Atomic Fermi Gas: three-body recombination and domain formation*, Eur. Phys. J. B **89**, 180 (2016)

[33] **Lei Wang**, *Discovering Phase Transitions with Unsupervised Learning*, Phys. Rev. B **94**, 195105 (2016)

[34] Li Huang, Yilin Wang, **Lei Wang**, Philipp Werner, *Detecting phase transitions and crossovers in Hubbard models using the fidelity susceptibility*, Phys. Rev. B **94**, 235110 (2016)

[35] Li Huang, **Lei Wang**, *Accelerate Monte Carlo Simulations with Restricted Boltzmann Machines*, Phys. Rev. B **95**, 035105 (2017)

Eprints on arxiv

`http://arxiv.org/a/wang_l_1`

[1] Zi Cai, **Lei Wang**, Jian Li, Shu Chen, X. C. Xie and Yupeng Wang. *D-wave bosonic pair in an optical lattice*, arXiv:0910.0508

[2] **Lei Wang**, Jia-Ning Zhuang, Xi Dai and X. C. Xie. *An Impurity Solver Using the Time-Dependent Variational Matrix Product State Approach*, arXiv: 1001.2943

[3] **Lei Wang**, Hao Shi, Shiwei Zhang, Xiaoqun Wang, Xi Dai and X. C. Xie. *Charge-density-wave and topological transitions in interacting Haldane model*, arXiv:1012.5163

[4] **Lei Wang**, Troels F. Rønnow, Sergio Boixo, Sergei V. Isakov, Zhihui Wang, David Wecker, Daniel A. Lidar, John M. Martinis and Matthias Troyer. *Comment on: "Classical signature of quantum annealing"* , arXiv:1305.5837

[5] Bela Bauer, **Lei Wang**, Iztok Pižorn, Matthias Troyer. *Entanglement as a resource in adiabatic quantum optimization*, arXiv:1501.06914

[6] Li Huang, Yi-feng Yang, **Lei Wang**, Recommender Engine for Continuous Time Quantum Monte Carlo Methods, arXiv:1612.01871

Selected Talks

Oct 2008 **Mott Physics and Magnetism in the Optical Lattice**, *Oklahoma State University physics department seminar*, Stillwater, USA.

Aug 2009 **Variational Matrix Product State Approach as an Impurity Solver**, *The Sixth Joint Meeting of Chinese Physicists Worldwide (OCPA6)*, Lanzhou, China.

Jan 2010 **Time evolution algorithm based on Monte Carlo Method**, *KITPC seminar*, Beijing, China.

Sep 2010 **Time evolution of quantum many-body systems: A game of life, death and birth in Slater determinant space**, *2010 Annual Meeting of Chinese Physical Society*, Tianjin, China.

Aug 2011 **Interaction effect on topological insulator: studies based on interacting Greens functions**, *Workshop on Emergence in Field Theory*, Nanyang Technological University, Singapore.

Feb 2012 **Density functional theory for static and dynamical properties of cold atomic gases**, *2nd NCCR QSIT General Meeting*, Arosa, Switzerland.

June 2012 **Density functional theory for static and dynamical properties of cold atomic gases**, *Quantum Systems and Technology*, Monte Verita, Switzerland.

Aug 2012 **Density functional theory for static and dynamical properties of cold atomic gases**, *The 6th national conference on cold atom physics and quantum information for young researchers*, Jinhua, China.

Jan 2013 **Topological charge pumping of cold atoms**, *Workshop on orbital physics in cold atom systems*, IOP Beijing, China.

Feb 2013 **Simulating dynamics and topological phases of cold fermionic gases**, *Finite-temperature non-equilibrium superfluid systems*, Queenstown, New Zealand.

June 2013 **Topological charge pumping of cold atoms**, *Topological Phases in Condensed Matter and Cold Atom Systems: towards quantum computations*, Cargese, France.

Aug 2013 **Topological charge pumping of cold atoms**, *The 7th national conference on cold atom physics and quantum information for young researchers*, Tunxi, China.

May 2014 **Spinless fermions on a honeycomb lattice: from quantum criticality to topological superconductors**, *KITPC Program on Precision Many-body Physics of Strongly correlated Quantum Matter*, KITPC Beijing, China.

Feb 2015 **Surprises in simulation of quantum phase transitions**, *Workshop on Quantum Simulations*, Benasque, Spain.

April 2015 **Simulation of Hubbard Models in the Era of Synthetic Gauge Field**, *CECAM Workshop on Computational Many-Body Physics in the Era of Artificial Gauge Fields*, LMU, Germany.

October 2015 **Recent progresses on diagrammatic determinantal approach of lattice fermions**, *Advances in Diagrammatic Monte Carlo Methods for Quantum Field Theory Calculations in Nuclear, Particle, and Condensed Matter Physics*, ECT* Trento, Italy.

April 23, 2016 **New Adventures in Quantum Monte Carlo Method - How Did I Earn an Erdős Number of Two?**, *The 6th Workshop on Quantum Many-Body Computation*, Beijing Computational Science Research Center, China.

June 30, 2016 **Simulation of Hubbard Models in the Era of Synthetic Gauge Field**, *2016 Hangzhou Symposium on Degenerate Fermi Gases*, Zhejiang University, China.

July 18, 2016 **Simulation of Hubbard Models in the Era of Synthetic Gauge Field**, *The 10th national conference on cold atom physics for young researchers*, Wuhan, China.

September 4, 2016 **Machine Learning for Many-body Physics**, *2016 CPS Fall Meeting*, Beijing, China.

December 13, 2016 **Machine Learning for Many-body Physics**, *Fourth Workshop on Tensor Network States-Algorithms and Applications*, Hsinchu, Taiwan.

December 24, 2016 **Machine Learning for Many-body Physics**, *Mini-workshop on computational physics*, Dali, China.

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